(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 067 752 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
10.01.2001 Bulletin 2001/02

(51) Int. Cl.[7]: **H04M 15/00**

(21) Application number: **00113450.1**

(22) Date of filing: **18.01.1996**

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
LT LV SI

(30) Priority: **30.01.1995 US 381704**

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
96905183.8 / 0 808 547

(71) Applicant:
TELEMAC CELLULAR CORPORATION
Danville, CA 94526 (US)

(72) Inventors:
- **McGregor, Donald Scott**
  Danville, CA 94526 (US)
- **McGregor, Gregory M.**
  Danville, CA 94526 (US)

(74) Representative:
Heusch, Christian
c/o OK pat AG,
Hinterbergstrasse 36
6330 Cham (CH)

(54) Mobile telephone system, computer program, wireless hand-holdable telephone unit and method for making or keeping a mobile telephone unit active

(57) The system comprises telephone units each with a processor (56), memory (58, 66) and internal accounting code means; the code means includes an account with representation of available funds, charge rates, and a billing algorithm for classifying calls into billing categories, select a charge rate, calculate a charge in real time and subtract it from the account. A host processor (14) operated by a system provider, serving for coordination of accounts, receiving and storing mobile unit information including identification and operating codes for the usage of the unit and communicating operating codes to units. The computer program is adapted to control the system and the units. The unit is adapted to work within the system. The method makes/keeps the unit active.

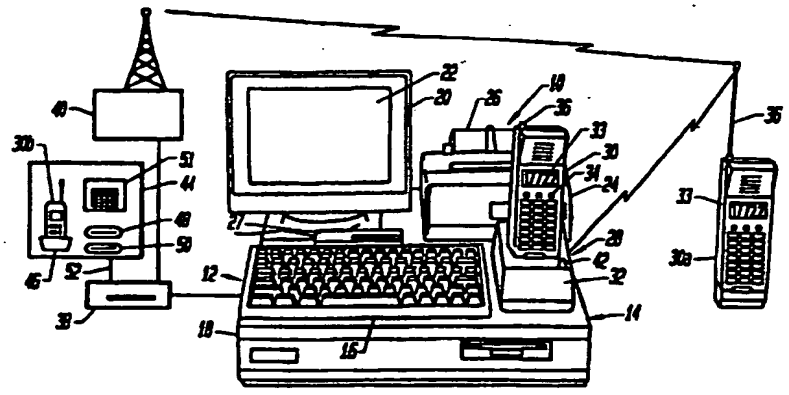

FIG. 1

EP 1 067 752 A1

Printed by Xerox (UK) Business Services
2.16.7 (HRS)/3.6

Description

[0001] The invention relates to a mobile telephone system in accordance with the preamble of claim 1, to a computer program for a mobile telephone system in accordance with the preamble of claim **38**, a wireless hand-holdable Telephone Unit in accordance with the preamble of claim **58** and a method for making or keeping a mobile telephone unit active in accordance with the preamble of claim **87**

[0002] Calculation of costs in telecommunication as well as credit and debit systems in relation with telecommunication are problems which are well known and which have been the object of many inventions in the last years.

[0003] ***US-3,459,882*** *by* ***Gabriel*** et al discloses a battery powered pay-for viewing device and describes an early pre-paid use system.

[0004] ***US-3,531,586*** by ***Bass*** et al discloses a broadcast system for transmitting debit signals for use in pay programming such as pay television.

[0005] ***US-3,725,947*** by ***Albertini*** et al discloses an automobile timekeeping and accounting unit and includes a keyboard for data entry as well as a printer for statements and reports. In one embodiment telephone usage is recorded for appropriate client billing using identity codes.

[0006] ***US-3,938,091*** by ***Acalla*** et al discloses a password system suitable for use in making a credit card telephone call where a secret password is entered into the device which generates a code word and the code word together with the password are input to a verification machine for authenticating a match between them before further proceeding.

[0007] ***US-3,938,091*** by ***Mondardini*** et al discloses a calling card system in which a personal phone number and a dialling code are used to effect debiting charges. It describes the basic calling card system used in Europe.

[0008] ***US-4,635,285*** by ***Coombes*** describes a two-way radio communication system of the simplex type or the half-duplex-type having a communication link to a duplex telephone system wherein the simplex radio is provided with priority to talk on demand. The communication protocols provide priority to the remote station over the land station for improved communication.

[0009] ***US-4,706,275*** by ***Kamil*** discloses a prepayment method for a telephone system in which the user can use any telephone for completing telephone calls and the call costs are debited from a prepaid account. In essence, the users special calling code operates similar to a system in which calls are charged to one's 'home' telephone number.

[0010] ***US-4,831,647*** by ***D'Avello*** et al discloses a system for authenticating a credit card information for a car phone system by passing transmitted credit card data to the service provider which is relayed to a registration computer for the credit card check.

[0011] ***US-4,860,341*** by ***D'Avello*** et al discloses a similar system to the system disclosed just above.

[0012] ***US-4,839,829*** by ***Freedman*** describes a system for automated control of printing from a remote location, wherein the remote central processing unit communicates with multiple terminals from a remote site through a modem. The remote terminals are connected to a printer and the printer is operated under remote control through the modem lines by the central processing unit.

[0013] ***US-4,916,621*** by ***Bean*** et al discloses a portable microprocessor-based data collection unit adapted for traffic detectors from which it can be disconnected without loss of data. The device includes a microprocessor, real-time and data storage all interconnected in one circuit.

[0014] ***US-4,951,308*** by ***Bishop*** et al describes a mobile cellular telephone system adapted to the rental market wherein phone usage is calculated by estimated duration of the calls as related to the discharge of the battery unit for the cellular telephone. Also disclosed is the use of a vending machine in which a telephone unit can be obtained by a customer through use of the customers credit card.

[0015] ***US-4,958,368*** by ***Parker*** discloses a customer activation system that allows remote activation by an agent through communication with a regional process via a data entry device.The system establishes a customer file. The customer activation system automatically enters teh customer information, accomplishes the customer credit checking, assigns the telephone number with switch insertion and activation of the new number and billing activation for the new customer. No debit system is disclosed including no disclosure of how to set up, fund or operate a debit account.

[0016] ***US-4,965,812*** by ***Bishop*** et al discloses a system for automating the checkout of a car equipped with a cellular telephone unit at a car rental station. The telephone unit is associated with a card reader that initiates a communication between the telephone unit and a custom administration computer for collecting various data from the card. Input of the card by the customer provides a contract for signature and verification of the customers drivers license.

[0017] ***US-5,020,091*** by ***Krolopp*** et al discloses a radiotelephone with a plurality of telephone numbers for use in different systems areas. A received SID is compared with the stored SIDs, and if a match is found the new number is used. If no match is found the telephone unit is a roaming unit and enters an semi-idle state only receiving incoming calls.

[0018] ***US-5,023,936*** by ***Szczutkowski*** et al discloses a digital radio transceiver in the form of a programmable telephone unit that includes security arrangements enabling and disabling certain features after manufacture or at the time

of purchase of the telephone unit. In this way a multiple feature unit can be tailored to different configurations from basic to added channels, DTMF capability etc.

[0019] ***US-5,046,189*** by ***Molnar*** describes a communication system in which a plurality of local subscriber ports communicate with a central controller which receives digital data from terminals at the ports. The controller processes the data and responds by initiating execution of certain predetermined features, the effects being executed at the remote terminals.

[0020] ***US-5,109,401*** by ***Hattori*** et al discloses a mobile telephone unit with a user controlled account reference for appraising the user of call charges. A communication session is established with the carrier, only for transmitting a call rate to the telephone unit, not for programming or activating the telephone unit.

[0021] ***US-5,127,041*** by ***O'Sullivan*** describes a system for interfacing computers to a generic-type modem. The modem enables cable connection to cellular transceiver units of different manufacture. The modem solves the problem of a use of a modem for normal computer connections and use of a separated modem for each different interface that may be desired for data transfer.

[0022] ***US-5,134,651*** by ***Ortiz*** discloses a call supervision system for detecting completion of national and international calls. Also disclosed is an autonomous pay phone arrangement including a billing system for a mobile telephone unit to calculate call charges for immediate payment after calls have been made. A CPU control board memory stores billing rates for services to be provided such as different pre-charges for calculating a call charge. No debit system is disclosed neither can a phone be activated by a host processor.

[0023] ***US-5,138,650*** by ***Stahl*** et al, to which correspond ***WO-92 06549*** and ***EP-0 550 618,*** discloses a system to control the expenses of international calls from a mobile phone by using a stored charge limit. In some embodiments, charge calculations can be made within the mobile phone unit, the charge rates must be obtained from the base station. Since there is no table of rates, the billing algorithm is not capable of internally categorizing the phone calls, which is a drawback of this system.

[0024] ***US-5,144,649*** by ***Zicker*** et al describes a method for operating a communication system with a plurality of cellular radio-telephone units having credit card readers. Communication sessions with a remote programming host are held for transmission of data including credit card data to the host, for validating and unlocking the unit so that a call may be placed. The call data include number, call, time, duration and system identification number and are recorded in a call record for each call of the unit. Accumulated unit data is uploaded to the credit card host processor on a daily basis during off-peak hours. A fraud threshold is connected which disconnects the unit when it is exceeded.

[0025] ***US-5,148,474*** by ***Haralambopoulos*** et al discloses a method for accounting for value added telecommunication services such as US 700-services or US 900-services or similar services.

[0026] ***US-5,203,014*** by ***Wagai*** et al describes a telecommunication device in form of a pager which is able to receive message and service information from a base station. By using appropriate multiple identification codes different alerting signals can be produced for the user of the pager to distinguish between message transfer and service information transfer.

[0027] ***US-5,220,593*** by ***Zicker*** et al describes how credit card information can be checked locally in order to avoid repeated calls to the network to gather information. Also disclosed is how call records which are accumulated in memory means of the debit telephone unit can be uploaded to the credit card host during off-peak hours to help prepare the final credit card bill. No debit system is described.

[0028] ***US-5,233,642*** by ***Renton*** describes a mobile telephone unit which generates and collects detail record information related to the usage of a mobile telephone system which is compatible with conventional telephone devices. A communication interface transfers the call detail record information to a stationary unit containing a computer and an evaluation program, where the usage is evaluated. In this way billings for rental use of cellular telephones are provided to verify billings. The evaluation program is independent of the microprocessor and program used for the call detail record information and collection.

[0029] ***US-5,233,656*** by ***Langrand*** et al describes a security system for transferring rental data to and from a rental telephone unit. Key data are used which include a public key and a private variable key, allowing encoding and decoding of secret telephone rental data in a network to prevent fraudulent transactions. Transfer of phone rental data from a main authorisation center to auxiliary authorisation sub-centers enables authorised roaming services.

[0030] ***US-5,276,729*** by ***Higuchi*** et at discloses a wireless telephone programmable by a remote programming unit. DTMF tones are used which are converted into digital signals. The programming can be restricted by requiring the user of the unit to enter either a password or a security code stored in the memory of the remote programming unit. The memory unit also has a number of roam access bins. Comprised are a host processor unit, a remote programming unit and a programmable wireless telephone unit.

[0031] ***US-5,297,191*** by ***Gerszberg*** discloses a system to download an assignment number and parameters to a memory of a mobile telephone unit, so that cellular service is initiated. Since the mobile unit initiates the dialogue with the service provider, the activation system is primarily used for service switches as opposed to initiating a new service. In one embodiment a modem is used for purging the communication path between the telecommunication service

center and the mobile unit. After having established a voice communication channel the system is switched to a data transfer via the modem of the unit and the communication system modem for transfer of changed parameters. Alternative methods are disclosed for adaption to other digital/analog systems. The system comprises remote programming but no security precautions.

[0032] ***US-5,297,192*** by ***Gerszberg*** discloses a system similar to the system described just above.

[0033] ***US-5,301,233*** by ***Amadon*** et at describes a real time accounting system for a mobile telephone unit. This system is useful for a rental unit and designed to be used with the units users credit card number. The real time system collects call data from the service provider and initiates billing on a daily or other time basis for use by the rental agency. The calculations are performed externally of the unit, i.e. at the telephone switching office

[0034] ***US-5,303,285*** by ***Kerihuel*** et al discloses a call security system for a radio-telephone service. A valid user is authenticated by using a secret key known only to the caller and a random number, a call signature is generated using a predetermined algorithm. The control points of the service provider have databases with words identifying a subscriber and a subscriber key for decoding the secret data emitted by the subscriber when a call is initiated.

[0035] ***US-5303,297*** by ***Hillis*** discloses a dynamic billing system adapting to the system load in real time. A user about to make a call receives a rate charge; if the rate charge is acceptable he makes the call, if not he places the call later at a moment where the charge rate is lower.

[0036] ***US-5,309,500*** by ***Koma*** et al discloses a cellular mobile telephone unit with a time display mode and a telephone mode. In the time display mode the unit constantly receives area identifying code, and on crossing a boundary line the time difference is entered. The reference is noted as a method an electronic clock can count pulses from a time case and generate time of day data.

[0037] ***US-5,335,278*** by ***Matchett*** et al discloses a system for preventing fraud. The system includes a central database for pulling data from a plurality of local sites. This data is transmitted to each site of the system and is updated from time to time, thus enabling the local service provider to compare aces codes for telephone units placing a call, specially from a site which is not the callers main service provider. Various methods of encrypting the data and storing ESN/MIN data including PIN data are disclosed, but it is not explained how the PIN is obtained.

[0038] ***US-5,359,182*** by ***Schilling*** discloses a communication system with a wireless telephone unit and a debit card. The credit for the user is carried on the debit card and the debit telephone number is the telephone number of the debit card, not the specific telephone unit being used. Credit data and debit data is transmitted to the service provider at the time calls are made for adjustment of the debit card account.

[0039] ***US-5,361,297*** by ***Ortiz*** et al discloses a call supervision system for completion of national and international calls. Additionally disclosed is an autonomous pay telephone arrangement including a billing system for a mobile telephone unit for calculation of charges for immediate payment. A CPU control board memory stores billing rates for services to be provided such as local and long distance incoming and outgoing pre-charges and the like for calculating a call charge when the phone is used.

[0040] ***US-5,384,776*** by ***Gulliford*** et al discloses a digitally trunked radio frequency communications system for routing audio signals between an audio source and any of a plurality of station destinations, the system being suitable for a mobile communications network.

[0041] ***US-5,386,455*** by ***Cooper*** et al discloses a custom method for activating a cellular telephone unit using a local CPU that is connected via a modem to the locale service carriers computer. In the process the cellular telephone establishes a direct communication link through its iinput/output data interference terminal. The direct connection between the local CPU by modem with the local carrier authorisation computer enables the phone unit to be programmed and assigned its identification number during a communication session. No debit system is disclosed including no disclosure of how to set up, fund or operate a debit account.

[0042] ***US-5,446,759*** by ***Campagna*** discloses a wireless transmission system suitable for transmitting information streams to mobile receivers such as cellular telephone units, pagers and other wireless devices, the system sending two information streams that are time delayed, which streams are synchronised and combined by the receivers to eliminate errors caused intervals of signal fading to produce error-free transmission of information.

[0043] ***US-5,631,947*** and corresponding ***WO-92 16078*** by ***Wittstein*** et al discloses a mobile telephone device for a rental system including a telephone handset and associated computer for calculating phone usage charges consisting of call charges and rental charges, and also for storing these charges for transfer of the phone usage data to a rental station computer terminal in order to prepare a bill. The telephone device also includes a use limit enforcement routine for disabling the telephone unit when the charge limit will be exceeded.

[0044] ***US-5,722,067*** by ***Fougnies*** et al discloses a security method for authorising wireless telephone calls of prepaying subscribers with cellular telephones which are pre-programmed with a pre-selected number and an automated number identification code which - on calls - first directs the call through to a host computer that accesses a subscriber account data base with an account balance that is decremented during the authorised call.

[0045] ***WO-94 28670*** by ***Tuohino et al*** describes a method for apprising users of a mobile telephone unit in advance of the rate which will be charged for a call. A separate communication with the network is required to obtain

this rate information before the call is placed. If the caller thinks the rate quoted by the network is too high, he can choose not to make the call.

[0046] ***GB-2 265 522*** by ***Barnes et al*** describes a system which is meant to be used not in a cellular system but in a system consisting of a relatively fixed base station and a matching handset; This means that there is not a plurality of roving handsets for each base stations. Prepayment arranged for the mobile phone unit requires repeated communication between the base station and the mobile phone unit for account processing.

[0047] ***JP-3-45031*** by ***Anritsu*** discloses a portable telephone handset having information storage means for storing call charge units, the value of which corresponds to the amount of payment made for purchase or rental of the phone. The units are reduced each time a billing signal is received per a timing interval corresponding to a line distance based on an area identification. The handset is deactivated when the units are depleted. Also mentioned is that a billing rate table in which rates are based on regions and a clock can be comprised in a portable handset and that the handset can perform the same billing registration and calculation processes as when billing signals were received from a base station. However no implementation of this alternative is described. Roaming, international calls and other features which make a billing algorithm complex are not mentioned. It is mentioned that the handset can be taken to a designated agency for updating the call unit information and for recharging the battery. However no interaction with a host processor is disclosed.

[0048] ***JP-3-80756*** by ***Anritsu*** discloses a portable telephone unit having a call storing means which stores the call charge unit value that corresponds to prepaid call charges obtained when the is connected to a public pay telephone and a card is inserted or coins deposited to replenish the portable telephone handset with a desired call charge unit value. During calls, the call charge unit value is gradually reduced. No details of the manner in which the call charges are calculated are disclosed. An alternative embodiment is disclosed which allows the battery to be charged at a level equivalent to the level of call charge unit value. In both alternatives, when call charge units are used, the handset can be refilled without going to a particular agency, but to the closest public telephone. No host processor is involved in coordination accounts.

[0049] ***JP-3-60229*** by ***Anritsu*** discloses a portable telephone handset that is used in a rental business and includes an internal means to detect and store call charge units used for calls, and means to display or to output the used call charge units after a rental period. The handset includes also a clock circuit to provide date/time data for discounts, and a time data storage means for call duration per call charge unit for area code zones from different areas. Also disclosed is an alternative embodiment in which a rental fee for a certain number of call charge units can be collected in advance and a call charge unit deducted each time a call charge unit signal is generated. Details of implementing are not described.

[0050] ***JP-3-280652*** by ***NTT*** discloses a mobile rental terminal where the user pays call charges in advance, and when accumulated call charges exceed the amount which the user has prepaid, the communication terminal is disabled. Further disclosed are procedures for entry of a monetary amount that includes the use of passwords and indicates that calls are billed based on a charge index and on call duration. Although an external computer is mentioned for entry of monetary amount, the use of a host processor for controlling the phone accounts is not mentioned.

[0051] It is the object if the invention, to provide for

- a mobile telephone system as mentioned with an accounting system; the accounting system should allow that, within each phone unit, i.e. without a communication between the phone unit and a base station, the amount due by the user of the phone unit for a call being made is determined and deducted from a limited fund; the accounting system should be able to work as a debit system, whereby the limited fund is a prepaid amount or the rest of a prepaid amount; the accounting system should also be able to work as a credit system, whereby the limited fund is a limited credit or the rest of a limited credit;
- a computer program which is adapted to work within said mobile telephone system;
- a hand-holdable telephone unit which may be used within said system and with said computer program; and
- a method for making and keeping said telephone unit active.

[0052] This object is achieved

- for the telephone system by the features of characterizing portion of claim 1;
- for the computer program by the features of characterizing portion of claim 38;
- for the hand-holdable telephone unit by the features of characterizing portion of claim 58; and
- for the method by the features of characterizing portion of claim 87.

[0053] Preferred embodiments of the telephone system, the computer program, the telephone unit and the method to activate the telephone unit are defined by the respective dependent claims.

[0054] The invention provides essentially for a mobile phone system with a mobile telephone accounting protocol

for mobile phone units, and in particular to cellular phones and radio-phones that are capable of moving from one transceiver to another in a communication network. In particular, the mobile telephone accounting protocol is adapted for a mobile debit or credit account phone in which the communication traffic with the service provider is mini-mized to expand traffic handling capacity of the service provider by accomplishing the accounting procedures within each mobile phone unit. The mobile telephone accounting protocol is similar to that described in ***US- 5,325,418***, which is incorporated herein by reference. In the referenced patent, an accounting system is described which has particular application to a rental phone system or a controlled phone system, such as an intra-corporate system where periodic calculation of phone charges are made prior to receipt of billings from public or switched service providers. In such systems, phone call data is stored in the mobile phone unit and charges are calculated by a host processor after a dialogue is established between the host processor and the phone unit. This system requires that a communication link be established between the host processor and the mobile phone unit and may require that the phone unit be physically connected to the host processor.

[0055] Account systems with internal debit and credit memory for cordless phones which have been previously proposed do not account for the particular complexities of mobile phone systems wherein multiple service providers may be involved in a communication network and the mobile phone is allowed to move or roam across defined zones or cells within a particular service area or across multiple service areas. In such situations, the location of the mobile phone making the call is as important for billing calculations as the location of the phone or stations being called. This added complexity complicates billing procedures for mobile phones and increases the communication session required for remote debit systems, thereby adding to airway traffic.

[0056] In addition to the objective of eliminating an accounting session with a service provider for each call made, the mobile phone unit, when adapted to work within a debit system, with internal accounting capabilities as disclosed by the invention greatly expands the potential customer base by enabling persons with inadequate credit to obtain mobile phone service by the use of a pay-as-you-go debit account. In this case, the credit risk is avoided by prepayment of service and call charges, and where credit is extended permits the credit to be provided by an entity other than the service provider, for example by the seller of the phone, or by a billing service that provides credit or pre-paid accounts for mobile phone users. The risk is also excluded when the system works as a credit system, since a certain limited credit is fixed, wherefrom call costs are deducted, and calls are interrupted as soon as the total call costs of all calls exhausts this credit limit.

[0057] The mobile phone unit of this invention can be used with a mobile phone rental system as described in reference ***US-5,325,418***. Because the mobile phone unit itself includes the accounting capabilities, the rental system can be greatly expanded, allowing the return station to have minimum system hardware, and indeed, requiring only the ordinary equipment necessary to clear an account, collect the charges and store the returned phone for pick-up or return to an initiating station. The mobile phone unit itself calculates the charges on the fly and provides a cumulative account record for review at the return station. The mobile phone system of this invention is adapted for analog or digital cellular telephones, radiophones in personal communication service networks (PCS's) and other wireless communication systems where it is desirable that call accounting be done on the fly.

[0058] The mobile phone system with mobile phone units having internal accounting of this invention relates to wireless communication systems having mobile communication devices, particularly mobile telephones that are part of a wireless communication network. In particular, it relates to a mobile communication device, such as a mobile telephone unit that includes an internal accounting protocol for internal calculation of communication charges on the fly. Such mobile telephone units or mobile phone units are typically cellular telephones in a cellular phone network, radio telephones in a personal communication service network or other communication system where the communication device is moveable from place to place and requires a complex accounting system for calculating calling charges in real time or on the fly.

[0059] Although the primary intended use of the mobile phone system of this invention is intended for mobile debit phone units, the invention is useful where real time calculation of phone charges is necessary to limit phone use or to immediately bill for phone use where the billings of public switched service providers and involved wireless service providers are not yet available.

[0060] A real time accounting system carried internally in the mobile phone unit greatly expands the potential customer base for such units and coupled with certain activation and deactivation features allows a new segment of business to become involved in the mobile communications industry. Because credit responsibility can be shifted from the service provider, retailers, billing services, and a host of intermediate entities can be integrated between the phone user and the service provider. Additionally, the service provider can expand its customer base by providing mobile debit phones to its customers with a pre-paid phone credit or with a pre-approved credit limit that will deactivate the phone unit if credit is exhausted or credit is not extended by the airway activation and credit transfer procedures that form a part of this mobile phone system. In this manner, the credit risk is limited to an acceptable predefined level.

[0061] The accounting system that provides these features is carried internally in the mobile communication device, for convenience, hereafter called the mobile phone unit. The accounting system includes a complex billing algorithm

with multiple factor accounting protocol to account for different call categories, e.g. call categories with local charges, roaming charges when the mobile phone unit moves from one zone to another, long distance charges, international charges including country independent local charges, and surcharges which may be per call or rate based; for one or several call categories accounting may be made for different rates like peak rates or off-peak rates, whereby different rates may not only depend on the time of day but also on the day of the week. The rates which actually have be applied for a certain call may be determined internally by a clock device or externally triggered by the system. The complex billing algorithm can be expanded to accommodate special charges of service providers or called stations or special discounts or premiums for data transfer calls.

[0062] The complex algorithm is stored within the phone unit, together with a rate schedule. The rate schedule may be periodically updated, preferably at off-peak hours, by a wireless communication with a host or service provider.

[0063] It is to be understood that the mobile phone unit with internal accounting can be implemented into existing wireless communication networks without substantial modification to the network and can be implemented into most existing mobile communication devices with minimal modification, primarily by internal reprogramming of the device.

[0064] A mobile phone unit such as a cellular telephone currently includes an internal processor and sufficient internal memory to incorporate the programming and data storage necessary to accomplish the real time accounting. The complex algorithm providing the multiple factor accounting protocol is sufficiently compact that storage and processing of the call data is enabled in real time with sufficient accuracy to account for multiple charges from multiple service providers even for a roaming phone unit. The accounting protocol enables internal tracking of phone usage with activation and deactivation of the phone unit to insure unauthorized usage is prevented. The accounting protocol further includes an encryption system to permit activation and licensed use of the phone unit, and account credit transfers on the fly over the airways.

[0065] These and other features of the mobile phone system with internal accounting in the mobile phone units will become apparent upon consideration of the detailed description of the preferred embodiments that follows and wherein

Fig. 1 is a perspective view of the components of the mobile phone accounting system of this invention with part of the system shown schematically, and.

Fig. 2 is a schematic view of the basic internal components of a mobile phone unit.

[0066] Referring to **Fig. 1**, the mobile phone accounting system of this invention is designated generally by the reference numeral **10**, and illustrates a stand-alone, tracking and accounting unit **12** that may be used by a rental agency or by a mobile phone dispensing center such as a retail store, or a center associated with a wireless service provider.

[0067] The tracking and accounting unit **12** includes a central processing unit **14** that combines a data entry keyboard **16** coupled to a controller or data processor **18**, which in turn is coupled to a monitor **20** having a display screen **22** for tracking data entry and review. Also connected to the processor **18** are peripheral components including a printer **24**, here with a continuous paper roll **26** for printing statements, receipts, customer and service provider contracts, and the like, and a credit card reader **27** for credit verification.

[0068] Included in one embodiment of the tracking unit **18** of the mobile phone accounting system is direct couple, interlink receiver **28**, shown with an installed hand-holdable or hand-held, mobile phone unit **30**. The interlink receiver **28** structurally forms a boot **32** into which the cellular phone unit **30** is inserted for direct, electronic coupling of the phone unit **30** and the data processor **18** of the central processing unit **14**. As many of the accounting functions of the accounting system are preferred internally in the phone unit **30**, satellite processors for activating and programming phone units require only a personal computer with a modem and a bus connect to the connection port of the phone unit.

[0069] In the arrangement of **Fig. 1**, the interlink receiver functions as a terminal interconnect allowing for direct 'hard wire' communication between the data processor **18** and the mobile phone unit **30** through the connection port of the phone unit **30**. Programming and activation of the phone unit **30** can be accomplished by the processing unit **14** through the interlink receiver with minimal security procedures. The processing unit **14** is particularly useful in opening new customer accounts and includes the necessary data base format for assigning a phone to a user and tracking the assigned phone as described in detail in co-pending application of parent application of present divisional application, entitled, 'MOBILE PHONE DISTRIBUTION SYSTEM', Serial No. 08/265,373, filed 23 June 1994, now ***US-5,625,669***.

[0070] The mobile phone unit **30** is preferably a contemporary unit with an LCD display screen **33** for display of phone numbers, account data, and other numeric or alphanumeric data to signal a user with a message during a call that an impending deactivation of the phone unit **30** is near. The phone unit **30** includes conventional circuitry and firmware to perform the customary communication, transmission and reception function, as shown in **Fig. 2**. The phone unit **30** has a transceiver antenna **36** for wireless communication, and as described hereafter, can be activated and programmed over the airways.

[0071] In the embodiment of **Fig. 1**, the central processing unit **14** includes a modem **38** that is linked to a transceiver station **40** for establishing a wireless communication link to a phone unit 30a, shown with its antenna extended

for transmission and reception. The transceiver station **40** may be part of the mobile phone system common to the central processing unit **14** and owned by the system provider, or may be owned by an external service provider and part of the external communications network that includes the public switching network.

[0072] In this mode of operation, the central processing unit **14** communicates via hardwire, possibly through a public service network to the RF transmission station **40** for remote processing between the central processing unit **14** and the mobile phone unit **30a**. Alternately, a low level transceiver **42**, preferably with control circuitry located within the interlink receiver **28**, provides for RF communication with the phone unit **30a** within local range. This feature is useful in retail centers where it is desired that the central processing unit **14** be located in a computer room and sales clerks communicating with a customer, communicate to the central processing unit through one or more floor terminals with limited processing capabilities for security reasons.

[0073] Since the mobile phone unit **30** includes the necessary accounting functions to internally maintain a user's call account, at least within a rental period or within period of periodic update to the central processing unit **14**, the unit 30 and a transaction station **44** need only verify the validity of a money transfer or credit transfer. When functioning as a debit phone, the phone can continue to operate until the account is exhausted, without contact with the system provider. The transaction station **44** shown in **Fig. 1** includes an interlink receiver boot **46** in which is installed a mobile phone unit **30b**. The transaction station **44** includes a cash receiving slot **48** for receiving cash for increasing the internal pre-paid account of the phone. The transaction station **44** also includes a card slot **50** for receiving pre-paid phone cards or credit cards and a key pad **51** for data entry. Verification of the value of phone cards and credit card may be accomplished by a stand alone transaction station **44**; however, to prevent fraud it is preferred that a transaction station **44** having a card reader be connected by a communication line **52**, as shown, to credit verification center, here the central processing unit **14** via the modem **38**. The phone card is a discardable credit card-like device having a magnetic strip coded with a pre-paid amount and can be sold independently of the phone system. To prevent reuse of dispensed cards by reprogramming the magnetic strip, the card is voided upon use, and the card serial number is centrally logged as void.

[0074] Similarly, to provide an opportunity for a credit card verification, the use of a direct communication tine **52** to the modem **38** or alternately to a local credit agency is preferred. The transaction station **44** also includes a key pad **54** allowing a user to select the amount to be added to the internal account in the phone. In this manner, where the mobile phone user desires to increase his phone use account amount without a dialogue with the system provider, there is an opportunity to do so. The call data in the phone unit is dumped to the transaction station or cleared to permit the accumulation of new data related to the upgrade account. Alternatively, where an account has been established with the system provider, which may be an entity different from the wireless service provider with whom the system may contract, the mobile phone user may request an increase in the internal debit account by contacting the system provider over the airways as shown by the phone unit **30a** in **Fig. 1**.

[0075] Referring to **Fig. 2**, a generalized electronic schematic is shown of the typical mobile phone unit **30** used in the system here described. The phone unit **30** includes a processor **56** that acts as a controller to coordinate the functions of the unit **30**. The processor **56** has an associated nonvolatile memory comprising an EPROM chip **58** or other flash device which stores the executable firmware that forms the core operating code of the unit and command codes as well as data storage, for example for rate tables and logging the call data. Also, closely associated with the controller is a clock chip or rather a timer chip **64**, which provides a timer for calls. In the preferred mobile phone unit **30**, the clock chip or timer chip **64** is a real time chip that provides time and date for improved call logging and for greater flexibility in phone use plans. Use of a real time clock chip is not required for the described mobile phone accounting system, but allows for full use of the logging and tracking features. Additionally, certain features such as deactivation of the phone of a set date is accomplished using a real time clock chip. Call counters and cumulative time limits for deactivation may be served by a timer chip. Alternatively, the element of the mobile phone unit **30** comprising the processor **56**, the ROM **58**, the RAM **60**, and the clock **64**, may be embedded in an intelligent phone component such as a Subscriber Identification Module SIM card.

[0076] Airway communication is provided through the antenna **36**, which is connected to an RF transceiver connected to the processor **56** and to an analog audio circuit **68** with an ear phone output **70** and a microphone input **72**. The audio circuit **68** is also connected to the processor **56** for audio output of touch-tones, warning signals and the like. The phone unit **30** includes DTMF decoder chip **72** and a keypad **76** for data entry, such as telephone numbers, and DTMF signals for code and data dialogues with the central processor over the airways. Alternatively, Short Message Service SMS, Unstructured Supplementary Services Data USSD, General Packet Radio Services GPRS, High Speed Circuit Switched Data HSCSD and other over the air data bearer communication services can also be used for code and data exchanges between the phone and the central processor. Code and data exchanges between the hone and the central processor can be used for such functions as activation of the phone, deactivation of the phone, replenishing the dollar or other currency amount of the internal account, changing the billing algorithm, and changing the data table. Preferably, the phone unit **30** includes a LCD display screen **33** as noted to visibly warn of a forced termination of a call because of loss of credit or the like. Audio warnings are transmitted through the earphone **74**. The phone unit **30** is pow-

ered by a battery pack **78**.

[0077] Ordinarily, by displacing certain features in a manufacturer's stock phone unit, such as the storage of frequently called numbers in a cellular phone, the nonvolatile memory sufficiently large to accept the complex billing algorithm and the command set necessary to convert a cellular phone to a real time billing phone. Where the existing memory is inadequate, modification by installation of additional memory will allow incorporation of the conversion code and data. For example, in a newly designed phone, the new auxiliary firmware in including parts of the complex billing algorithm and much of the command set, could advantageously be allocated to ROM or any other nonvolatile memory, with changeable data such as the rate tables and call log allocated to RAM.

[0078] The phone unit **30** or SIM component of the phone respectively when received from the manufacturer includes identification information like a fixed Electronic Serial Number ESN unique to each phone. To be functional, the phone unit is programmed and this may be accomplished individually, as described in ***US-5,325,418*** or in batch mode as described in the referenced application. The existing ESN and Group Identification Mark GIM are read and stored. The Number Assignment Module NAM is run, to assign the Mobile Identification Number MIN, System Identification Number SIN and other network parameters to activate a phone unit for general use. The MIN is the assigned telephone number for the unit and should be one of the last numbers assigned, if step programming is accomplished to preserve a working inventory of available MINs. Step programming may be desired where a batch of phones are programmed and assigned to a service provider identified by SID, which then assigns a phone to a customer at the service provider's location. The names and acronyms for the telephone unit identification and telephone network access parameters will vary with different implementations of the mobile equipment and network.

[0079] Customarily, the phones are programmed by installing the phone unit in an interlink receiver **28** in the central processor unit **14** or at a remote terminal connected to the central processor unit. The phone unit **30** can alternately be activated and programmed on the fly by use of the messaging capabilities of the phone unit via the DTMF signals or other over the air communication protocol as described hereafter. This feature allows remote programming of the phone over the airways via the transceiver station without the necessity of the direct connection of the phone port connector to the central processor unit **14**.

[0080] In the mobile phone system of this invention where the mobile phone unit has internal accounting capabilities, the phone unit is programmed with the code responsive to the command set, the complex billing algorithm, the license code and other parameters allowing the phone unit to be a periodically polled unit, for example, in a rental environment, or a debit unit, where account status can be determined and upgraded on the fly. The following table, **Table I**, lists the command set. The command set is suitable for most modern cellular type phones and it is understood that modifications may be required for phone units of different types or different manufacturers. As noted, certain commands may not be operational where the hardware includes a clock chip that does to provide real time and date, and suitable modification is required.

TABLE I

BASE COMMANDS	DESCRIPTION
RD_PHONE_NUMBER	Read the telephone's phone number
RD_PHONE_CALLS	Read the telephone's call data activity storage
RD_PHONE_TIME	Read the current time from the phone
WR_PHONE_TIME	Set the current time from the phone
RD_PHONE_RTB	Read the phone's software revision number
LOCK_PHONE	Lock the phone from use
UNLOCK_PHONE	Unlock phone for use
RD_CALL_COUNTER	Read the number of calls made during the period
RD_COMMAND_STATUS	Read status of last command issued
RESET_CALLS_MEMORY	Reset/erase the call activity storage data
RESET_CALLS_COUNTER	Reset the call counter to 0
RESTRICT_ILLEGAL_CALLS	Restrict all illegal calls
ENABLE_ALL_CALLS	Deactivate the call restriction
RD_TELEPHONE_ESN	Read the phone's electronic serial number
WR_NAM	Write NAM parameters to the phone
RD_NAM	Read the current NAM parameters from

	the phone
WR_SCRATCH_PAD	Store a small amount of data in the phone
RD_SCRATCH_PAD	Read the small amount of data from the phone
WR_LOCK_DATE	Set the date at which the phone will no longer function
RD_LOCK_DATE	Read the lock data from the phone
REGISTRATION	System provider registers itself for use with the phone. (Password is transmitted)

DEBIT COMMANDS	**DESCRIPTION**
WR_CONF_DATA	Write debit configuration data to the phone
RD_CONF_DATA	Read the configuration data from the phone
WR_DOLLAR_AMOUNT	Write the maximum dollar amount the phone can be used
RD_DOLLAR_AMOUNT	Read the maximum dollar amount from the phone
DO_CALL_TRACKING	Turn on call tracking
NO_CALL_TRACKING	Turn off call tracking
DO_DEBIT_MODE	Turn on debit mode billing
NO_DEBIT_MODE	Turn off debit mode billing
ENABLE_AIR_ACTIVATION	Turn on over the air debit activation of funds
DISABLE_AIR_ACTIVATION	Turn off over the air debit activation of funds
UPDATE_DEBIT_DATA1	Update, over the air, the current additional dollar amount and date of expiration referencing the Telephone License Number

OTHER RESPONSES	**DESCRIPTION**
ACK	Acknowledgment
NAK	Could not understand HOST/PP or Invalid LRC

OTHER INTERACTIVE COMMANDS	**DESCRIPTION**

USING THE PHONE KEY BOARD	
VIEW_CURRENT_AMOUNT	View the current dollar amount left for debit
UPDATE_DEBIT_DATA2	If for some reason the „over the air" updating of the debit data cannot be successfully completed, the user can be given a license number to manually type in using the keypad via this function

[0081] A suggested protocol for the command set in Table I uses the acronyms in the following table:

TABLE II

Acronym	Description
HOST	A systems operator's Personal Computer will be considered the host
PP	The phone unit will be considered the host Phone Peripheral
DB	A Data Byte
CB	A Command Byte
CTI	A Cellular Telephone Interface
ACK	An Acknowledgment from the phone unit
NAK	The PP or HOST did not understand the last set of data retrieved
BCD	Binary Coded Decimal

[0082] The host computer comprises the central processing unit **14** of **Fig. 1** or a satellite computer that is preferably connected to the central processing unit **14** which acts as a hub for system wide coordination of accounting and tracking information. The host computer, which may be a typical higher end PC communicates to the phone units via a bus using a standard Asynchronous RS-232 serial port at 9600 band, no parity, 1 stop bit, 8 data bits or a customized interface tailored to a particular manufacturers phone unit. Where programming the initial activation of a phone unit over the airway, the initial dialogue is accomplished using DTMF signals or other over the air communications protocol. A factory phone has limited calling capability, typically 911 for emergency. The factory phones are preprogrammed to allow an additional dedicated 800 number, the number of the system provider service center. Once the connect is made by voice dialogue, the service operator initiates the code and data exchange program. Phone unit identification like e.g. ESN is checked by the HOST and if verified as an authorized phone for assignment by the HOST, the NAM parameters are programmed to the phone unit (PP). The programming of the phone as an internal accounting phone is also accomplished using over the air communication protocol such as DTMF signals. Because of security reasons, it is preferred that the phone unit be programmed through the bus by direct connection as previously described. The code and data transmission to the phone could also be encrypted by the central processor and decrypted by the phone and the code and data transmission to the central processor be encrypted by the phone and decrypted by the central processor.

[0083] A suggested data format for the command set listed in **Table I** is set forth in the following paragraphs:

RD_PHONE_NUMBER

HOST and PP Interaction:

HOST sends CB to PP
PP sends DBS + LRC (Longitudinal Redundancy Check)

Data From Phone:

DBS is an ASCII string representation of the MIN. eg. 5108382400

LRC Calculation

The LRC, Longitudinal Redundance Check, is calculated by the following algorithm:

```
b = 0x00
LOOP I=0 to length of data
b=b XOR data[I]
LRC = b
```

The LRC is used when any data bytes, DB, are sent to the PP or from the PP

RD_PHONE_CALLS

HOST an PP Interaction:

HOST sends RD_CALLS_COUNTER to PP
PP sends back DB for the call counter to HOST
HOST sends CB to PP
PP sends back all call data to HOST followed by an LRC byte (Longitudinal Redundancy Check) (The bytes coming back would be number of calls * 17 + 1 for the LRC)

WR_PHONE_TIME

HOST and PP Interaction:

HOST sends CB + DB(4) + LRC to PP (The LRC would include the CB)
PP sends back an ACK to HOST

Data sent to phone:

The CB, RD_PHONE_TIME, is sent followed by 4 bytes containing the MMDDHHMM in BCD. The month, day, hour and minute are each in the form of a BCD byte

Example:

eg. for January 1, 1980 at 1 pm the DB would look like 01011300 where 01, 01, 13 and 00 are all bytes

RD_PHONE_TIME

HOST and PP Interaction:

HOST sends a CB to PP
PP sends back a DB(4) + LRC to HOST

Data sent form phone

The data sent from the phone is identical to the data sent to the phone in WR_PHONE_TIME

Example:

eg.. For Feb. 2, 1999 at 2:12pm the DB bytes would look like 02021412 etc...

RD_PHONE_RTB

HOST and PP Interaction:

HOST sends a CB to PP

PP sends back its firmware revision number in some format relevant to the phone + LRC

Data sent from phone:

TBD. Specific to the manufacturers phone

LOCK_PHONE

When the phone is in „locked" mode, the phone should display the word „LOCKED" on the main viewing screen. The phone is completely deactivated while in this mode until the HOST issues the UNLOCK_PHONE command. The purpose of this mode is to secure the phone in between rentals or debit-rentals. While in this mode, it prevents users, or employees, from stealing air time. Also, if the phone is stolen while in this mode, the phone is worthless. This worthlessness provides a sense of security for the supplier of the phones.

HOST and PP Interaction:

HOST sends a CB to PP

PP send back an ACK to HOST

UNLOCK_PHONE

This mode is just opposite the LOCK_PHONE or „LOCKED" mode. In this mode, the phone is completely usable.

HOST and PP Interaction:

HOST sends GB to PP

PP sends an ACK to HOST

RD_CALL_COUNTER

This comment allows the HOST to read the current number of calls that have been made on this phone during this rental. From there, the HOST can use this as data to present to the user and use this data to determine the number of bytes the phone will send when issued the RD_PHONE_CALLS command.

Host and PP Interaction:

HOST sends CB to PP

PP sends DB(2) + LRC to HOST

The two data bytes are 16 bits from most significant bit to least significant bit. These two bytes represent the number of calls that have been made on the telephone. The last, or third byte, is an LRC.

RD_COMMAND_STATUS

At any point during the PP interrogation by the HOST, the HOST can issue this command byte, CB, to determine the state of the last command sent. Even though ACK's and LRC's are used, this provides a general status check on the PP.

HOST and PP Interaction:

HOST sends CB to PP + LRC

PP sends back DB(2) + LRC to HOST

Data Sent From PP:

The DB byte sent from the phone can be used to diagnose internal problems that have occurred in the phone. If the last command and the current state of the phone are good, the DB should be 0x0l. The rest of the bytes values can be left up to the manufacturer to decide what phone specific information can be returned via this byte.

RESET_CALLS_MEMORY

If the DO_CALL_TRACKING has been turned on during a rental period, the phone will have been storing call data in memory blocks of 17 bytes per call. This command is used to either clear the memory or simply reset a pointer in memory to the call data.

HOST and PP Interaction:

HOST sends a CB to PP + LRC
PP sends an ACK to HOST

RESTRICT ILLEGAL_CALLS

This feature allows the service provider to restrict certain calls right at the source; at the phone, based on a pattern in the phone number.

HOST and PP Interaction:

HOST sends a CB + DB(63) + LRC to PP
PP sends an ACK to HOST

Data Sent From Host:

KL = Key length, digit count to use for the search	1 byte
KEY = The actual digits for the search	7 bytes
ODS = Offset from the end of the digit string to search	1 byte
Total:	9 bytes

The total number of numbers to block is 7 which gives us 7 * 9 = 63 bytes of configuration data.

ENABLE_ALL_CALLS

This command disables the call restriction feature. If this command has been issued to the phone, then steps 2.0 and 2.1 are executed in the call restriction algorithm. On the other hand, if the RESTRICT_ILLEGAL_CALLS is issued to the phone with the configuration data, the phone would be placed in call restriction mode.

HOST and PP Interaction:

HOST sends CB to PP + LRC
PP sends ACK to HOST

RD_TELEPHONE_ESN

The HOST requests the ESN and the phone transmits the ESN to the HOST. The ESN or other phone identification information is the nonchangeable part in the NAM that phones or SIM components of phones can be tracked by.

HOST and PP Interaction:

HOST sends CB to PP
PP sends DB(x) + LRC to HOST

Data Sent to HOST:

The data that is sent to the HOST is dependent on the format the manufacturer is using.

WR_NAM

Writing the NAM via the HOST provides some benefits which are:

1. Mis-programming by employees which leads to bad service;

2. Fraud prevention in that the phone can only be programmed via this command; therefore, this deters an individual from simply stealing a rental phone and getting service somewhere else;

3. Safely and effectively moving phones from place to place; and

4. No training is required at the rental/debit site to activate the telephone.

The following is a general list of parameters that would need to be programmed in an analog cellular phone:

- MIN, Mobile Identification Number
- SID, System ID (A side is an odd number while the B side is an even number)
- GIM, Group Identification Mark/ID (Typically 0-15)
- LUM, Local Usage Mark (0 or 1)
- EX, Min Class (0 or 1)
- ACCOLC, Access Overload Class (0 + last digit of the MIN)
- LOCK, The User's Lock Code
- SS, The System Select (A-Only, B-Only, or Standard A-B/B-A mode)
- ICPH, Initial Paging Channel (334 B, 333 A)

The names and acronyms for the telephone unit identification and telephone network access parameters will vary with different implementations of the mobile equipment and network.

HOST and Interaction:

HOST sends CB + DB(X) + LRC to PP
PP sends ACK to HOST

Data Sent To PP:

The NAM data is somewhat standardized, however, each phone manufacturer usually has a built in protocol for doing just this.

RD_NAM

The RD_NAM, or read NAM, functions just the opposite of WR_NAM or write NAM. Again, this is typically already set up in a manufacturers phone.

HOST and PP Interaction:

HOST sends CB to PP
PP sends DB(X) + LRC to HOST

WR_SCRATCH_PAD

This „scratch pad" memory is a segment of memory that the system provider can use to store important information in the phone. This information can be credit information, rental information or multi-site drop off information. By having the ability to store a small amount of data in the phone, the system provider can open the doors to many new features. This also provides the system provider with the ability to allow for future updates in the software that can take advantage of this memory Any size greater than or equal to 1K, 1024 bytes, is adequate.

HOST and PP Interaction:

HOST sends GB + DB(X) + LRC to PP
PP sends an ACK to HOST

RD_SCRATCH_PAD

This is just the opposite of WR_SCRATCH_PAD. With this command, the phone would send the „scratch pad' memory to the HOST.

HOST and PP Interaction:

HOST sends CB to PP
PP sends DB(X) + LRC to HOST

WR_LOCK_DATE

Creates the ability to tell the phone to shut off at some date.

HOST and PP Interaction:

HOST sends CB + DB(3) + LRC to PP
PP sends an ACK to HOST

Data Sent To PP:

The data date format is slightly different in that it contains no time information and does contain year information. The BCD format YYMMDD.

Example:

July 21, 1968 would be 680721

RD_LOCK_DATE

This is just the opposite of WR_LOCK_DATE. This is used to verify or find out what the current lock date is in the phone.

HOST and PP Interaction:

HOST sends CB to PP
PP sends DB(3) + LRC to HOST

Data Sent To Host:

The data DB(3) is a date in the format described in WR_LOCK_DATE.

REGISTRATION

This REGISTRATION command acts as a security feature for the phone manufacturer and the system provider. Before any HOST and PP interaction can occur, the HOST must send this command followed by the password. From that point on, any command issued should work. If this command has not been issued, then the PP should not respond to any HOST commands.

HOST and PP Interaction:

HOST sends CB + DB(16) + LRC to PP
PP sends DB(16) + LRC to HOST

Data sent to PP

The data password may be a default password selected by the system provider.

Data sent to HOST:

The data is then echoed back to the HOST. This helps show the relationship between the system provider and a customer such as a telephone vendor.

WR_CONF_DATA

This is the configuration structure that contains all the necessary parameters for providing a debit service. This data includes items such dialing information, relates and other configuration information, including the complex billing algorithm that permits internal accounting within the phone unit. Once this data is in place and the DO_DEBIT_MODE command is given, the phone will begin using this information to process call charges.

RD_CONF_DATA

This command will read back the configuration data that was written by WR_CONF_DATA.

HOST and PP Interaction:

HOST Sends a CB to PP
PP sends DB(X) + LRC to PP

Data From Phone:

This data (DB(X) is the size of the data structure discussed in WR_CONF_DATA. This may vary depending on implementation and phone restrictions. Following the data, there should be an LRC.

WR_DOLLAR_AMOUNT

This command is used to update the current dollar limit in the phone. Since this is a single command there stands great risk for fraud. So there is a bit of extra data that helps deter fraud built in.

HOST and PP Interaction:

HOST sends CB + LICENSE NUMBER +LRC to PP
PP sends an ACK to HOST

Data sent to phone:

The HOST will send a CB then a valid license number followed by an LRC. This license number is the same license number that is transmitted „over the air" to the phone or manually imput via the key pad.

RD_DOLLAR_AMOUNT

This command returns the current dollar amount in the phone.

HOST and PP Interaction:

HOST sends a CB to PP
PP sends DB(2) + LRC to HOST

Data sent to host:

The DB(2) data in the two bytes of dollar data with the Most Significant bit first and Least Significant bit last.

Example:

DB(2) = 00 02 which would translate to the value 2

DO_CALL_TRACKING

This command turns on the call tracking feature. If the phone is in call tracking mode, the phone will save, see the RD_PHONE_CALLS command, all calls made so that they may be used to bill the user at a later time.

HOST and PP Interaction:

HOST sends a CB to PP
PP sends an ACK to HOST

NO_CALL_TRACKING

This command turns on the call tracking feature. This command is useful when the supplier of phones wishes to leave a phone out in the field for long or indefinite periods of time. This command might be used in setting up debit phones at the factory or distribution center so that they would be ready for the retail market.

HOST and PP Interaction:

HOST sends a CB to PP
PP sends an ACK to HOST

DO_DEBIT_MODE

This command tells the phone to begin the processing and using the WR_CONF_DATA and

WR_DOLLAR_AMOUNT's data. When this mode is active, the phone begins to watch each phone call, debiting money as the phone is in use. Based on the configuration data supplied by WR_CONF_DATA the phone would decrement the WR_DOLLAR_AMOUNT each minute as the phone is in use.

HOST and PP Interaction:

HOST sends a CB to PP
PP sends an ACK to HOST

NO_DEBIT_MODE

This command tells the phone not to do debit processing. This will most likely be used whenever a customer wants to track calls of a user on a periodic basis as in a rental situation. Again, if call tracking is on and this command is issued, calls are only tracked and the phone should lock when the memory is full.

HOST and PP Interaction:

HOST sends a CB to PP
PP sends an ACK to HOST

ENABLE_AIR_ACTIVATION

The reason to provide the commands ENABLE_AIR_ACTIVATION and DISABLE_AIR ACTIVATION is for a customer that doesn't want over the air debit activation for its client users. By turning off the air activation, the customer has less room for fraud. This feature could also be used in creating a value added telephone or different models of the same phone etc.

HOST and PP Interaction:

HOST sends a CB to PP
PP sends an ACK to HOST

DISABLE_AIR_ACTIVATION

When this command is sent to the phone, the phone will no longer accept debit updates via DTMF tones or other over the air communication protocol. The only way a phone could then receive an update is via the keypad or via a self-service transaction station.

HOST and PP Interaction:

HOST sends a CB to PP
PP sends an ACK to HOST

[0084] When the foregoing command set has been implemented to establish the interface protocol between the HOST, here the central control unit **14**, and the PP, here the mobile phone unit **30**, the phone unit is programmed to respond to the HOST and to limited user commands as noted. The command set allows for a communication dialogue between the central control unit, or its surrogate, and the phone unit.

[0085] When the WR_CONF_DATA command is executed, the phone unit is loaded with the necessary data and code, including the complex billing algorithm to enable the phone unit to function as a debit phone upon entering and execution of the DO_DEBIT_MODE command.

[0086] The complex billing algorithm factors the multiple variables of a telephone call from a mobile phone into a billing equation that virtually mirrors the factors considered by public switched network providers and involved wireless service providers, (of which there may be more than one involved in a single call). The resultant call charge accurately approximates the summation of real charges that will be billed by the involved providers enabling an instant calculation of charges. Naturally, any error bias is programmed to favor the accounting system provider to minimize potential underbilling. By incorporating a rate table in the phone unit 30, dialogue with the system provider, which may be a separate entity from the wireless service provider, is thereby avoided. Since the rate table used by the complex billing algorithm may change at any time, the mobile phone system of this invention provides for over the air updating of the internal rate table in each phone unit at the initiation of the system provider. Each phone unit may be polled and updated by the system provider during off-hours. Preferably, the updated rate table is coded when the user applies for an increase in the internal phone account.

[0087] In describing the complex billing algorithm, the acronyms in **Table III** are used.

TABLE III

Acronyms		
BIT	1 bit of data	(Used as a flag)
BYTE	8 bits of unsigned type	(Like an unsigned char in C language
INT	16 bits of unsigned type	(Like an unsigned short int in C language)
BYTE[#]	Is a # of Bytes	(Like a storage buffer)
DECIMAL	Up to 32 bits	(Like a float in C/just a decimal number
RECORD	A collection of the above types	

[0088] The call record configuration structure that enables the billing data to be established for calculation of charges is set forth in **TABLE IV**.

TABLE IV

RECORD of configuration data //This data will tell the phone how to bill calls in any country in the world	
BYTE	Maximum International Digits
BYTE	Minimum International Digits
BYTE	Maximum Long Distant Digits
BYTE	Minimum Long Distant Digits
BYTE	Maximum Local Digits
BYTE	Minimum Local Digits
BYTE[7]	International Access Code
BYTE[7]	Long Distance Access Code
BYTE	Is long distance access code always required?
BYTE[7]	Third party prefix/Operator/Calling Card Digits
//Locator Information	
INT[5]	5 Home SIDs of the phone (Provides seamless roaming etc...)
INT[5]	5 Home area codes of the phone (Provides computability in congested areas)
//Rate Information	
DECIMAL	Base access per minute charge (Applies to all calls)
DECIMAL	Additional long distance per minute charges
DECIMAL	Additional International per minute charges
DECIMAL	Additional roaming per day charges
DECIMAL	Additional roaming per minute charges
DECIMAL	Additional operator assistance charges, calling card or third party billing, or call surcharge for call content
//Other Information	
BYTE	Base billing delay
BYTE[3]	By YYMMDD date, the phone will lock and display „DATE - LOCKED"
BYTE[7]	Non-billed area code (Expanded to handle 7 digit long distance for third world)
BYTE[3]	YYMMDD is the last date this phone was roaming on
BYTE[5][11]	A block of 5 non-billed phone numbers to call (i.e., 911 and any other user defined)
INT[20]	A block of 20 random numbers [1000,9999] if value for license number decoding)

[0089] The configuration data for the foregoing record fields is explained as follows:

- Maximum International Digits - This is the maximum length of a country's country code. For instance, the USA has a country code of 1 while Venezuela has a country code of 58. If these were the only two countries in the world, then the maximum international digits would be 2. This isn't the case and we typically have this set at either 3 or 5 depending on the billing demand.
- Minimum International Digits - This is the minimum length of a country code. This will, in almost all cases, be set to 1.
- Maximum Long Distance Digits - This is the maximum length of a city's area code. This varies greatly in third world countries. Here in the USA this will always be set at 3 because all area codes are a length of 3. However, some countries area codes range from 1 digit up to 5 or more digits.

- Minimum Long Distance Digits - This is just the opposite of the maximum for long distance. Again, for the USA this will always be set to 3 but will vary outside the USA.
- Maximum Local Digits - This is the maximum length of digits it takes to call a local number. Here in the USA it is fixed at 7. However, this varies greatly in other countries.
- Minimum Local Digits - This is the minimum length of digits it takes to place a local call. This varies greatly even if you are in the USA. This can be used to create different effects in billing. However, because of the scope of the debit phone, this will most likely always be set to 0 or the USA only. (0 would account for an incoming call)
- International Access Code - This is the required prefix that must be dialed to place a directly dialed international call. From the USA a customer would dial 011 + country code + city/area code + local digits in order to place an international call. This varies greatly from country to country. A length of 7 in the description above provides the system provider with the capability of serving places like the Caribbean. They require a standard 7 digit number as a prefix. (This is just an example of place in the Caribbean)
- Long Distance Access Code - This is the digit or digits that are required for a user to dial in order to place a long distance call. From the USA, the user would dial a 1+, sometimes called one plus dialing. In other countries, this varies from a simple 0 to some lengthy digits e.g., 108 for the Philippines.
- Is Long Distance Access Code Required - In some cellular systems, it is not required that you dial the long distance access code in order to place a long distance call. In San Francisco, for example, if one were to call Utah information, all one would have to do is dial 801-555-1212, 1-801-555-1212 would also get to the same place. If the long distance access code is required, it will help the accuracy of the billing algorithm.
- Third Party Prefix/Operator/Calling Card - This essentially is the digit that must be dialed to reach the operator. In the USA, 0 is the digit necessary to reach the operator. It also is the digit necessary to place a collect call or credit card call.
- Billing Delay - After X seconds have passed, billing will begin. Since the phone does not know exactly when the call has been connected, we have to approximate this connection. If the call lasts under this X seconds, then the user is not billed for the call. However, if the call lasts X seconds, then the user is billed from the time they hit SND to END or the call is dropped.
- Home SID - This is the cellular system ID this phone is assigned to.
- Home Area Code - This is the area code of the cellular phone number or MIN, Mobile Identification Number.
- Ease Access Per Minute Charge - This rate is added to every telephone call made. This is the base rate for the telephone call. The only way this rate would not be added in is if the Billing Delay had not been reached.
- Additional Per Minute Long Distance Charge - This rate is added upon the Base Access rate when the call placed is classified as a long distance call.
- Additional International Per Minute Charge - This rate is added upon the Base Access rate when the call placed is classified as an international call.
- Additional Roaming Per Day Charge - This rate is added upon the Base Access rate when the call is a roaming call and this charge has not been already been applied today.
- Additional Roaming Per Minute Charge - This rate is added upon the Base Access rate and possible the Additional Roaming Per Day Charge when the call is a roaming call.
- Additional Operator Assistance Charge - This rate is added upon the Base Access rate when the call starts with the Third Party Prefix/Operator digit(s) or is a surcharge for call connects identified as data transfer calls or the like.
- Lock Date - This is the date the phone will no longer function on. The phone will display „DATE - LOCKED" and will not be able to be used until it is reprogrammed via the HOST or a license number.
- Non-Billed Area Code - This is an area code or number that is to be billed. This would be set to 800 for the USA. (NOTE: Only the long distance part of the charge is not billed)
- Last Date Phone Was Roaming - This is used to store the last date the customer was charged Roaming Per Day. If a call is roaming and today isn't equal to the Last Date Phone Was Roaming, then the Roaming Per Day Charge would apply.
- Non-Billed Numbers - This is a block of at least 5 numbers of 11 digits in length that provides the flexibility not to bill for certain phone numbers called. Numbers like 911 or other special numbers such as *18 for roaming. Any Non-Billed Number can also be dialed even if the phone is out of money or locked. This way, if the user's phone runs out of money in debit mode, the user can use that very phone to call a Non-Billed Number, such as customer support, to increase their credit on the phone.
- Random Number Block - This is a block of numbers ranging from 1000-9999 that are used in decoding license numbers.

[0090] The basic complex billing algorithm calculates the call charges for the basic categories of local calls, longs distance calls, international calls and roaming calls. As the algorithm allows compounding of categories, the call types are a complex of factors, for example, incoming roaming long distance call. The algorithm is easily expanded to handle

other categories, for example data transfer calls, for which deductions or surcharges may apply. The preferred algorithm can also accommodate peak rates, off-peak rates, weekend rates, holiday rates, promotional rates etc. A mobile phone unit real time clock or network signal may be used to help categorize rates into peak/off-peak, weekend, holiday etc.

[0091] In classifying a call, the following factors are considered which cover virtually all situations:

- Local Call - If the call digit length is less than or equal to the Maximum Local Digits and the call digit length is greater than or equal to the Minimum Local digits, then this is a local call.

- Long Distance Call - First, long distance calls are the most cumbersome to classify because there are so many possibilities. However, this can be boiled down to a few tests.

  If the number starts with the Long Distance Access Code, then subtract the length of the Long Distance Access Code from the length of the call digits. (i.e., If I dial 1-510-838-2400 the length is 11 - 1 = 10)

  If the NEWLY calculated call digit length is less than or equal to (the Maximum Local Digits + the Maximum Long Distance Digits) and the call digit length is greater than or equal to (the Minimum Local Digits + the Minimum Long Distance Digits) then:

    If the call does not start with the Long Distance Access Code and the Long Distance Access Code Required flag is set to yes, then this call is not a legitimate long distance call. (This is helpful in the third world)

  The following special cases are considered:

- Is a Call Roaming?

  If the SID the phone is currently in when the call is placed is not equal to any of the 5 Home SIDs, then the call is roaming.

- Third Party Prefix/Operator Assisted Calls

  If any call begins with the Third Party Prefix, then the call is not to be billed at all.

- Billing Delay

  If a call lasts under the Billing Delay seconds, then the call is not to be billed at all.

- Date Locking

  If the current date is equal or greater than the current Lock Date, the phone should lock and display „DATE - LOCKED".

[0092] The following examples provide an overview on the manner calls are calculated:

M	= Number of minutes the call lasted
L	= Local Call Per Minute Charge
LD	= Long Distance Per Minute Charge
IT	= International Per Minute Charge
RD	= Roaming Per Day Charge
RM	= Roaming Per Minute Charge
Local	= M * L
Long Distance	= M * (L + LD)
International	= M * (L + IT)
Incoming Call	= M * L
Local Roaming Call	= M * (L +RM) + RD (If RD has not been applied today)
Long Distance Roaming	= M * (L + RM + LD) + RD (If RD has not been applied today)
International Roaming	= M * (L + RM + IT) + RD (If RD has not been applied today)

Once a call has been classified, as close to pressing SND as possible, the charges described above need to be tracked on a minute by minute basis. One reason might be that if a user gets a dropped call or some unexpected end of a call, the system provider wants to be able to bill the call as close to it can to the number of minutes the user actually talked. The phone updates the debit amount every minute on the minute during a call. So, for a local call, the minute-by-minute calculation might be as follows:

$$\text{Total Charge} = \text{Total Charge} + L$$

The user should be notified by a tone or set of tones in the earpiece and on the phone's screen or by the warning lights if there is less than 5 minutes of airtime left at the current rate of use.

[0093] The mobile phone system of this invention allows over the air activation and dialogue with the phone unit **30** using the messaging paging capability of a mobile phone with a receiver decoder for teh DTMF signals or the phones operating software for extracting code and data from other over the air communications protocols. The current allowable dollar amount in the internal account of the phone unit can then be upgraded over the air. During the code and data dialogue between the central processing unit of the system provider and the user's phone, the encrypted license number of the user's phone is transferred and verified. The user's account is checked to determine if upgrade is warranted or is flagged as a credit risk. The upgrade amount is encrypted and keyed to the encrypted license number and transferred to the user together with any update of the rate schedule.

[0094] When the user exhausts the amount in the internal account in the phone unit **30**, the phone unit is locked, and the display **33** shows 'EMPTY-LOCKED'.

[0095] Similarly, when the use period expires, the phone unit **30** becomes locked and the display **33** shows 'DATE-LOCKED', and is placed in paging mode.

[0096] The numbers preprogrammed at the factory can still be dialed, including the number of the system provider's customer service center, permitting the user to contact customer service for an account increase.

[0097] It is to be understood that all of the data security issues are not here addressed and the security measures to be implemented depend on the environment of use and the position of the system provider in the service network. Upgrades are phone specific and are verified internally in the phone using parameters unique to the phone unit. The license numbers, after verification, are not stored or known to the user except in encrypted form.

[0098] The mobile phone system of this invention provides substantial flexibility by the features described. Phone retailers can sell and activate phones on site without special equipment. Furthermore, phones with internal accounting allow for prepayment of service and call usage charges permitting the retailer to make credit judgment or cash sales independent of the service provider. Additionally, the task of the system provider can be assumed by the retailer, the service provider or an independent entity that assumes the risk or provides for only cash prepayment transactions.

[0099] While, in the foregoing, embodiments of the present invention have been set forth in considerable detail for the purposes of making a complete disclosure of the invention, it may be apparent to those of skill in the art that numerous changes may be made in such detail without departing from the spirit and principles of the invention.

Claims

1. A mobile telephone system, comprising

   - a plurality of wireless hand-holdable mobile telephone units for a plurality of users, whereby each user has at least one mobile telephone unit at his disposition, wherein each of the mobile telephone units comprises

     - a processor **(56)**,
     - memory **(58, 66)** associated with the processor, and
     - internal accounting code means;

   - a host processor **(14)** operated by a system provider for coordination of accounts of mobile telephone units; **characterized in that**
   - the internal accounting code means includes

     - a account with representation of available funds,
     - a plurality of charge rates, and
     - a billing algorithm adapted to

       - classify each of the phone calls into one of a plurality of billing categories,

- select one of said plurality of charge rates corresponding to said billing category,
- calculate an appropriate charge for each of the phone calls in real time by using said selected charge rate, and
- subtract this appropriate charge from the account

- the host processor has
  - means for storing
    - mobile telephone unit information including mobile telephone unit identification information,
    - operating codes needed for the usage of the mobile telephone unit,
  - means for receiving mobile telephone unit identification information from a particular mobile telephone unit or its user,
  - means for ascertaining the operating codes needed for mobile telephone unit's usage upon receipt of said mobile telephone identification information from said particular mobile telephone unit, and
  - means for communicating said operating codes to said particular mobile telephone unit or its user.

2. The telephone system in accordance with at least one of claims **1** and **3** to **37**, **characterized in that** the host processor further has
   - means for storing assignable telephone numbers
   - means for receiving information identifying the user's locale,
   - means for ascertaining an assignable telephone number which corresponds to the mobile telephone unit user's locale, and
   - means for communicating said assignable telephone number to said particular mobile telephone unit or its user upon said ascertaining.

3. The telephone system in accordance with at least one of claims **1** to **2** and **4** to **37**, **characterized in that** the internal accounting code means further includes means for storing call charges as record data in the memory.

4. The telephone system in accordance with at least one of claims **1** to **3** and **6** to **37**, **characterized in that** the host processor further has program means for initiating the communications link at a moment controlled by the system provider and activating a communication of record data of stored call charges from the mobile telephone unit to the system provider.

5. The telephone system in accordance with claim **4**, **characterized in that** said program means has means for periodic polling of the mobile telephone unit during off-peak hours.

6. The telephone system in accordance with at least one of claims **1** to **5** and **7** to **37**, **characterized in that** said means for communicating further includes security means for securely activating and communicating record data and/or stored call charges from the mobile telephone unit to the system provider.

7. The telephone system in accordance with at least one claims **1** to **6** and **8** to **37**, **characterized in that** it includes a clock device associated with the mobile telephone system.

8. The telephone system in accordance with claim **7**, **characterized in that** the clock device is a real time clock chip.

9. The telephone system in accordance with at least one of claims **1** to **8** and **10** to **37**, **characterized in that**

the billing categories include at least one billing category for at least one of several types of calls like e.g.

- local calls,
- long distance calls,
- roaming calls,
- international calls,
- data transfer calls.

10. The telephone system in accordance with at least one of claims **1** to **9** and **12** to **37**, **characterized in that** the charge rates corresponding to different billing categories are different.

11. The telephone system in accordance with at least one of claims **1** to **9** and **12** to **37**, **characterized in that** the charge rates corresponding to some or all different billing categories are the same.

12. The telephone system in accordance with claim **9**, **characterized in that** the billing categories comprise for at least one of said types of calls at least two different rates, like e.g.

- peak-rate,
- off-peak-rate,
- weekend-rate,
- holiday rate,
- promotional rate.

13. The telephone system in accordance with claim **12**, **characterized in that** the clock device determines which rate is applied for a call depending of the time of the day and/or the day of the week.

14. The telephone system in accordance with claim **12**, **characterized in that** a code provided by the network triggers the rate which is applied for a call.

15. The telephone system in accordance with at least one claims **1** to **14** and **16** to **37**, **characterized in that** said operating codes comprise specific operating codes needed for replenishing mobile telephone accounts.

16. The telephone system in accordance with at least one of claims **1** to **15** and **17** to **37**, **characterized in that** said operating codes comprise specific operating codes needed for mobile telephone unit activation.

17. The telephone system in accordance with at least one of claims **1** to **16** and **18** to **38**, **characterized in that** said operating codes comprise specific operating codes needed to change the charge rates.

18. The telephone system in accordance with at least one of claims **1** to **17** and **19** to **37**, **characterized in that** said operating codes comprise specific operating codes needed to change the billing algorithm.

19. The telephone system in accordance with at least one of claims **1** to **18** and **21** to **37** **characterized in that** said operating codes are communicated to the user by a system provider operator who has access to said host processor.

20. The telephone system in accordance with at least one of claims **1** to **18** and **21** to **37**, **characterized in that**

said operating codes are entered by the user into the mobile telephone unit by manually punching keys on the mobile telephone unit.

21. The telephone system in accordance with at least one of claims 1 to 19 and 22 to 37, **characterized in that** said operating codes are communicated over the airways directly from the host processor to the mobile telephone unit.

22. The telephone system in accordance with at least one of claims 1 to 19 and 23 to 37, **characterized in that** said operating codes are communicated over the air ways from the host processor to the mobile telephone unit using DTMF signals.

23. The telephone system in accordance with at least one of claims 1 to 19 and 24 to 37, **characterized in that** said operating codes are communicated over the airways from the host processor to the mobile phone unit using short message service (SMS) data bearer communication services.

24. The telephone system in accordance with at least one of claims 1 to 19 and 25 to 37, **characterized in that** said operating codes are communicated over the airways from the host processor to the mobile phone unit using unstructured supplementary services data (USSD) data bearer communications services.

25. The telephone system in accordance with at least one of claims 1 to 19 and 26 to 37, **characterized in that** said operating codes are communicated over the airways from the host processor to the mobile phone unit using general packet radio service (GPRS) data bearer communications services.

26. The telephone system in accordance with at least one of claims 1 to 19 and 27 to 37, **characterized in that** said operating codes are communicated over the airways from the host processor to the mobile phone unit using high speed circuit switched data (HSCSD) data bearer communications services.

27. The telephone system in accordance with at least one of claims 1 to 26 and 29 to 37, **characterized in that** the available funds in the account represent a credit limit.

28. The telephone system in accordance with at least one of claims 1 to 26 and 29 to 37, **characterized in that** the available funds in the account represent prepaid funds.

29. The telephone system in accordance with at least one of claims 1 to 28 and 30 to 37 **characterized in that** calls are prevented from being made, received or being continued under predetermined criteria by a call lock.

30. The telephone system in accordance with at least one of claims 1 to 29 and 32 to 37, **characterized in that** calls will be prevented or interrupted when the account has approached a predetermined difference to a zero balance.

31. The telephone system in accordance with at least one of claims 1 to 29 and 32 to 37 **characterized in that** calls will be prevented or interrupted when the account has a zero balance.

32. The telephone system in accordance with at least one of claims 28 to 31 and 33 to 37, **characterized in that** selected calls like emergency calls and/or calls to replenish the account are not prevented or interrupted.

33. The telephone system in accordance with at least one of claims 1 to **32** and **34** to **37**, **characterized in that**
it further includes a visual display of the account balance.

34. The telephone system in accordance with at least one of claims **1** to **33** and **35** to **37**, **characterized in that**
the operating codes are encrypted before being communicated to or from the particular mobile telephone unit or its user.

35. The telephone system in accordance with at least one of claims **1** to **34** and **36** to **37**, **characterized in that**
the processor (**56**), memory (**58, 66**) associated with the processor, and the internal accounting code means are implemented in the hand-holdable mobile telephone unit by means of a programmable subscriber identity module (SIM) or smart card.

36. The telephone system in accordance with at least one of claims **1** to **35** and **37**, **characterized in that**
the mobile telephone unit identification includes the telephone's electronic serial number (ESN, IMEI).

37. The telephone system in accordance with at least one of claims **1** to **36**, **characterized in that**
the mobile telephone unit identification includes the telephone's international mobile subscriber identity (IMSI).

38. A computer program comprising code means, said code means comprising:

- internal accounting code means for a wireless hand-holdable mobile telephone unit (**30, 30a**),
- external code means for a system provider's host processor (**14**),

characterized in that, when said program is run on a telephone system, said code means are adapted to perform the following steps:

- the internal code means for the wireless hand-holdable mobile telephone unit
  - establishes an account with a representation of available funds,
  - stores a plurality of charge rates, and
  - creates a billing algorithm which is adapted to
    - classify each of the phone calls into one of a plurality of billing categories,
    - select one of said plurality of charge rates corresponding to said billing category,
    - calculate an appropriate charge for each of the phone calls in real time by using said selected charge rate, and
    - subtract this appropriate charge from the account; and
- the external code means for the system provider's host processor
  - stores mobile telephone unit identification information, and
  - stores operating codes needed for the usage of the mobile telephone unit,
  - whereby, upon receipt of mobile telephone unit identification information from a particular mobile telephone unit or its user, the host processor code means is adapted
    - to ascertain the operating codes needed for the particular mobile telephone units usage, and
    - to communicate said operating codes to said particular mobile telephone unit or its user.

39. The computer program in accordance with at least one of claims **38** and **40** to **57**, **characterized in that**
the external code means for the system provider's host processor stores assignable telephone numbers (MIN, MSISDN), whereby, upon receipt of mobile telephone unit identification information and user local information from a particular mobile telephone unit or its user, the host processor code means is adapted to select an assignable telephone number corresponding to the user's locale and communicate said assignable telephone number to said particular mobile telephone unit or its user.

40. The computer program in accordance with at least one of claims **38** to **39** and **41** to **57**,
characterized in that
storing, ascertaining and communicating the operating codes for the usage of mobile telephone units comprises storing, ascertaining and communicating specific operating codes needed for replenishing mobile telephone unit accounts.

41. The computer program in accordance with at least one of claims **38** to **40** and **42** to **57**,
characterized in that
storing, ascertaining and communicating the operating codes for the usage of mobile telephone units comprises storing, ascertaining and communicating specific operating codes needed for mobile telephone unit activation.

42. The computer program in accordance with at least one of claims **38** to **41** and **43** to **57**,
characterized in that
storing, ascertaining and communicating the operating codes for the usage of mobile telephone units comprises storing, ascertaining and communicating specific operating codes needed to change the charge rates.

43. The computer program in accordance with at least one of claims **38** to **42** and **44** to **57**,
characterized in that
storing, ascertaining and communicating the operating codes for the usage of mobile telephone units comprises storing, ascertaining and communicating specific operating codes needed to change the billing algorithm.

44. The computer program in accordance with at least one of claims **38** to **43** and **45** to **57**,
characterized in that
the internal accounting code means for the telephone unit can ascertain whether a telephone call belongs to at least one of several types of calls like e.g.

- local calls,
- long distance calls,
- roaming calls,
- international calls,
- data transfer calls.

45. The computer program in accordance with claim **44**,
characterized in that
the internal accounting code means for the wireless mobile telephone unit can ascertain whether a call belonging to at least one of said types of calls also belongs rates like e.g.

- peak rates,
- off-peak rates,
- weekend rates,
- holiday rates,
- promotional rates.

46. The computer program in accordance with claim **45**,
characterized in that
a clock device determines which of said rates is applied for a call depending of the time of the day and/or the day of the week.

47. The computer program in accordance with claim **45**,
characterized in that
a code provided by the network triggers the rate which is applied for a call.

48. The computer program in accordance with at least one of claims **38** to **47** and **50** to **57**,
characterized in that
the available funds in the account represent a credit.

49. The computer program in accordance with at least one of claim **38** to **47** and **50** to **57**,
characterized in that

the available funds in the account represent prepaid funds.

50. The computer program in accordance with at least one of claims **38** to **49** and **51** to **57**, **characterized in that** the internal accounting code means for said telephone unit is adapted to prevent telephone calls from being made, received or being continued under predetermined criteria.

51. The computer program in accordance with at least one of claims **38** to **50** and **53** to **57**, **characterized in that** the internal accounting code means for said telephone unit prevents or interrupts calls when the account has approached a predetermined difference to a zero balance.

52. The computer program in accordance with at least one of claims **38** to **50** and **53** to **57**, **characterized in that** the internal accounting code means for said telephone unit prevents or interrupts calls when the account has a zero balance.

53. The computer program in accordance with at least one of claims **50** to **52** and **54** to **57**, **characterized in that** selected calls like emergency calls and/or calls to replenish the debit account are not prevented or interrupted.

54. The computer program in accordance with at least one of claims **38** to **53** and **55** to **57**, **characterized in that** the operating codes are encrypted before being communicated to or from the particular mobile telephone unit or its user.

55. The computer program in accordance with at least one of claims **38** to **54** and **56** to **57**, **characterized in that** the code means is implemented in the hand-holdable mobile telephone unit by means of a programmable subscriber identity module (SIM) or smart card.

56. The computer program in accordance with at least one of claims **38** to **55** and **57**, **characterized in that** the mobile telephone unit identification information includes the telephone's electronic serial number (ESN, IMEI).

57. The computer program in accordance with at least one of claims **38** to **56**, **characterized in that** the mobile telephone unit identification information includes the telephone's international subscriber identity (IMSI).

58. A wireless hand-holdable mobile telephone unit,

- operating within a telephone system including an account system, and
- comprising a transmitter (**66**), a receiver (**66**), a processor (**56**), memory (**58, 60**) and internal accounting code means,

characterized in that

the internal accounting code means includes

- an account with a representation of available funds,
- a plurality of charge rates,
- a billing algorithm which is adapted to
  - classify each phone call into one of a plurality of billing categories,
  - select one of said plurality of a charge rates corresponding to said that billing category,
  - calculate an appropriate charge for each of telephone calls in real time by using said selected charge rate, and
  - subtract this appropriate charge from said account.

59. The telephone unit in accordance with at least one of claims **58** and **61** to **86**, **characterized in that**

the available funds in the account represent a credit limit.

60. The telephone unit in accordance with at least one of claims 58 and 61 to 86,
characterized in that
the available funds in the account represent prepaid funds.

61. The telephone unit in accordance with at least one of claims 58 to 60 and 62 to 86,
characterized in that
the internal accounting code means for said telephone unit is adapted to prevent calls from being made, received or being continued under predetermined criteria.

62. The telephone unit in accordance with at least one of claims 58 to 61 and 64 to 86,
characterized in that
the internal accounting code means for said telephone unit is adapted to prevent or interrupt calls when the account has approached a predetermined difference to a zero balance.

63. The telephone unit in accordance with at least one of claims 58 to 61 and 64 to 86,
characterized in that
the internal accounting code means for said telephone unit is adapted to prevent or interrupt calls when the account has a zero balance.

64. The telephone unit in accordance with at least one of claims 61 to 63 and 65 to 86,
characterized in that
selected calls like emergency calls and/or calls to replenish the debit account are not prevented or interrupted.

65. The telephone unit in accordance with at least one of claims 58 to 64 and 66 to 86,
characterized in that
the internal accounting code means has the ability to accept and implement operating codes received from a system provider host processor (14).

66. The telephone unit in accordance with at least one of claims 58 to 65 and 67 to 88,
characterized in that
the billing categories include at least one billing category for at least one of several types of calls like e.g.

- local calls,
- long distance calls,
- roaming calls,
- international calls,
- data transfer calls.

67. The telephone unit in accordance with claim 66,
characterized in that
the billing categories comprise for at least one of said types of calls at least two different rates, like e.g.

- peak rate,
- off-peak rate,
- weekend rate,
- holiday rate,
- promotional rate.

68. The telephone unit in accordance with at least one of claims 67,
characterized in that
it includes a clock device for determining which rate to be applied for a call depending on the time of the day and/or the day of the week.

69. The telephone unit in accordance with at least one of claims 67,
characterized in that
it comprises means for receiving trigger signals from the network determining which rate is to be applied.

70. The telephone unit in accordance with at least one of claims **58** to **69** and **71** to **86**, **characterized in that** it comprises pre-programmed information, e.g. the service center telephone number or an emergency number.

71. The telephone unit in accordance with at least one claims **58** to **70** and **72** to **86**, **characterized in that** said operating codes are encrypted.

72. The telephone unit in accordance with at least one claims **58** to **71** and **74** to **86**, **characterized in that** the charge rates corresponding to different billing categories are different.

73. The telephone unit in accordance with at least one claims **58** to **71** and **74** to **86**, **characterized in that** the charge rates corresponding to some or all of the different billing categories are the same.

74. The telephone unit in accordance with at least one claims **58** to **73** and **75** to **86**, **characterized in that** said operating codes comprise specific operating codes needed for replenishing mobile telephone accounts.

75. The telephone unit in accordance with at least one claims **58** to **74** and **76** to **86**, **characterized in that** said operating codes comprise specific operating codes needed for mobile telephone unit activation.

76. The telephone unit in accordance with at least one claims **58** to **75** and **77** to **86**, **characterized in that** said operating codes comprise specific operating codes needed to change the rates.

77. The telephone unit in accordance with at least one claims **58** to **76** and **78** to **86**, **characterized in that** said operating codes comprise specific operating codes needed to change the billing algorithm.

78. The telephone unit in accordance with at least one of claims **58** to **77** and **79** to **86**, **characterized in that** said operating codes are communicated over the airways from the host processor to the telephone unit using DTMF signals.

79. The telephone unit in accordance with at least one of claims **58** to **78** and **80** to **86**, **characterized in that** said operating codes are communicated over the airways from the host processor to the telephone unit using short message service (SMS) data bearer communications services.

80. The telephone unit in accordance with at least one of claims **58** to **79** and **81** to **86**, **characterized in that** said operating codes are communicated over the airways from the host processor to the telephone unit using unstructured supplementary services data (USSD) data bearer communications services.

81. The telephone unit in accordance with at least one of claims **58** to **80** and **82** to **86**, **characterized in that** said operating codes are communicated over the airways from the host processor to the telephone unit using general packet radio service (GPRS) data bearer communications services.

82. The telephone unit in accordance with at least one of claims **58** to **81** and **83** to **86**, **characterized in that** said operating codes are communicated over the airways from the host processor to the telephone unit using high speed circuit switched data (HSCSD) data bearer communications services.

83. The telephone unit in accordance with at least one of claims **58** to **82** and **84** to **86**,

characterized in that
it further includes a visual display of the account balance.

84. The telephone unit in accordance with at least one of claims **58** to **83** and **85** to **88**
characterized in that
the processor (**56**), memory (**58, 66**) associated with the processor, and the internal accounting code means are implemented in the telephone unit by means of a subscriber identity module (SIM) or smart card.

85. The telephone unit in accordance with at least one of claims **58** to **84** and **86**,
characterized in that
the mobile telephone unit identification information includes the telephones electronic serial number (ESN, IMEI).

86. The telephone unit in accordance with at least one of claims **58** to **85**,
characterized in that
the mobile telephone unit identification information includes the telephones international mobile subscriber identity (IMSI).

87. A method for making or keeping a mobile accounting telephone unit (**30, 30a**) active within a telephone system including an accounting system run by a system provider,
characterized in that

- in a system provider's host processor (**14**) are stored:
  - mobile telephone unit identification information;
  - mobile telephone unit operating codes, and
- the mobile telephone unit or its user initiates communication with the system provider to make or keep the mobile telephone unit active including providing the system provider with information about the identity of the mobile telephone unit;
- the identity information are input into the system provider's host processor;
- from the system provider's host processor are retrieved operating codes needed to use the telephone unit,
- these operating codes are communicated to the mobile telephone unit or its user,
- these communicated operating codes are input into the mobile telephone unit,
  - to make or keep the mobile telephone unit active.

88. The method in accordance with at least one of claims **87** and **89** to **99**,
characterized in that

- in the system provider's host processor (**14**) are further stored assignable telephone numbers (MIN, MSISDN),
- from the system provider's host processor is further retrieved an assignable telephone number corresponding to the user location information;
- the assignable telephone number is also communicated to the mobile telephone unit or its user, and
- this assignable telephone number is also input into the mobile telephone unit.

89. The method in accordance with at least one of claims **87** to **88** and **90** to **99**,
characterized in that
the operating codes needed to use the telephone unit comprise specific operating codes to activate the telephone unit.

90. The method in accordance with at least one of claims **87** to **89** and **93** to **99**,
characterized in that
the operating codes needed to use the telephone unit comprise specific operating codes to establish an account balance.

91. The method in accordance with at least one of claims **87** to **90** and **93** to **99**,
characterized in that
the account to be established is a credit account.

92. The method in accordance with at least one of claims **87** to **90** and **93** to **99**,
characterized in that
the account to be established is a debit account.

93. The method in accordance with at least one of claims **87** to **92** and **94** to **99**,
characterized in that
said operating codes are communicated over the airways from the host processor to the telephone unit using DTMF signals.

94. The method in accordance with at least one of claims **87** to **89** and **93** to **99**,
characterized in that
said operating codes are communicated over the airways from the host processor to the telephone unit using short message service (SMS) data bearer communications services.

95. The method in accordance with at least one of claims **87** to **94** and **96** to **99**,
characterized in that
said operating codes are communicated over the airways from the host processor to the telephone unit using unstructured supplementary services data (USSD) data bearer communications services.

96. The method in accordance with at least one of claims **87** to **95** and **97** to **99**,
characterized in that
said operating codes are communicated over the airways from the host processor to the telephone unit using general packet radio service (GPRS) data bearer communications services.

97. The method in accordance with at least one of claims **87** to **96** and **98** to **99**,
characterized in that
said operating codes are communicated over the airways from the host processor to the telephone unit using high speed circuit switched data (HSCSD) data bearer communications services.

98. The method in accordance with at least one of claims **87** to **97** and **99**,
characterized in that
the operating codes are communicated to the mobile telephone unit or its user in encrypted form.

99. The method in accordance with at least one of claims **87** to **98**,
characterized in that
the mobile telephone unit identity information includes the telephone's electronic serial number (**ESN, IMEI**).

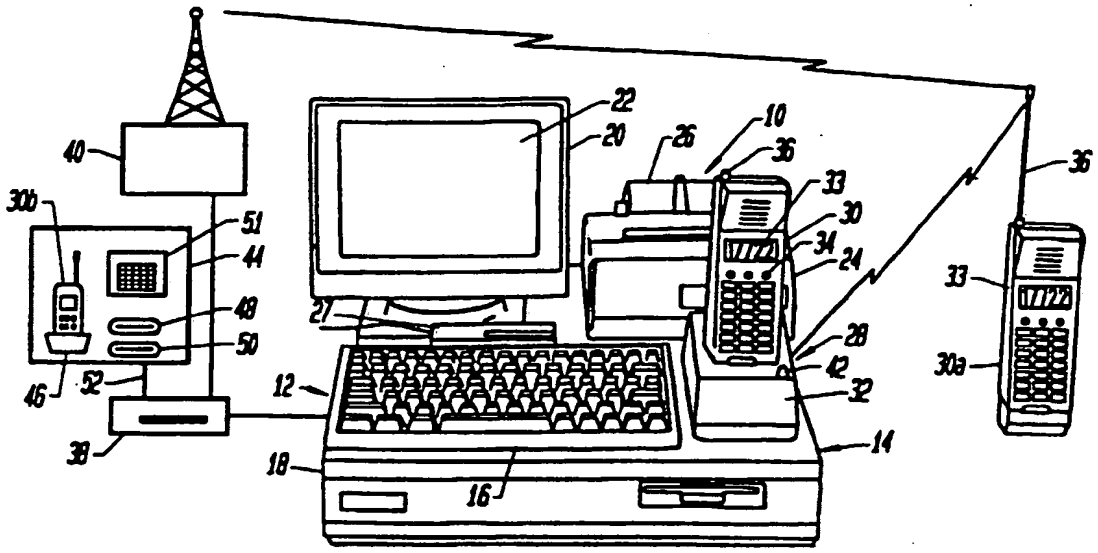

FIG. 1

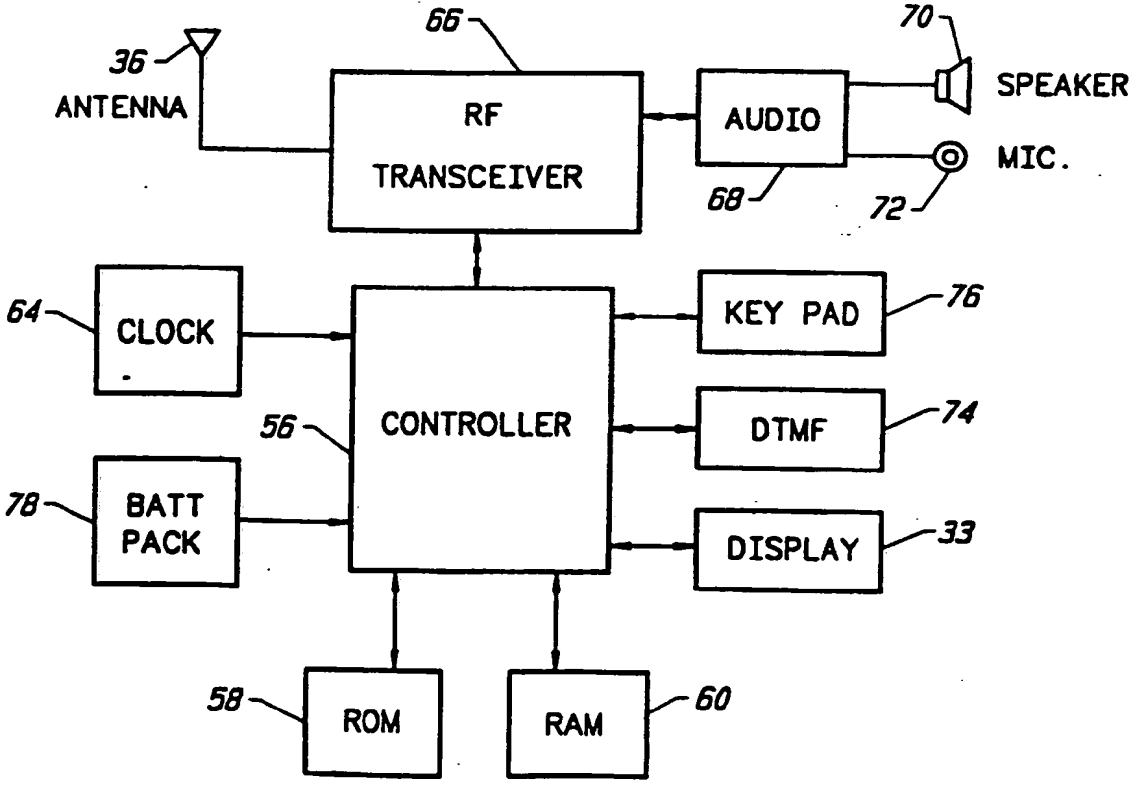

FIG. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 11 3450

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 5 138 650 A (BROWN DAVID L ET AL) 11 August 1992 (1992-08-11) * column 3, line 56 - column 4, line 23 * * column 5, line 61 - column 6, line 10 * * column 6, line 28 - line 38 *	87-99	H04M15/00
A		1,38,58	
A	WO 94 28670 A (NOKIA TELECOMMUNICATIONS OY ;SALMELA SEIJA (FI); LAATU JUHO (FI);) 8 December 1994 (1994-12-08) * page 3, line 8 - page 4, line 25 * * abstract *	1,38,58	
A	US 5 325 418 A (MCGREGOR DONALD S ET AL) 28 June 1994 (1994-06-28) * column 1, line 5 - line 28 * * column 1, line 62 - column 4, line 20 *	1,38,58	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			H04M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	13 November 2000	Dionisi, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 00 11 3450

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

13-11-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5138650 A	11-08-1992	AU 640829 B	02-09-1993
		AU 8636691 A	28-04-1992
		CA 2089367 A	28-03-1992
		DK 33593 A	23-03-1993
		EP 0550618 A	14-07-1993
		FI 931347 A	26-03-1993
		MX 9101136 A	04-05-1992
		NO 931162 A	29-03-1993
		WO 9206549 A	16-04-1992
WO 9428670 A	08-12-1994	FI 932480 A	01-12-1994
		AU 6798194 A	20-12-1994
US 5325418 A	28-06-1994	US 5625669 A	29-04-1997

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82